A Holistic Approach Towards a UML Profile for Business Modeling

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ABSTRACT

Due to faster and faster changing business conditions, companies must be able to quickly adopt these changes to their IT infrastructure. Thus, business models must reflect these changes in order to design/align business processes supporting the value exchanges defined in the business model. Presently there are three major and well-accepted business modeling techniques - e3-value, Resource-Event-Agent (REA) and the Business Modeling Ontology (BMO). All of them use their own proprietary notation, which is incompatible with UML - the de-facto modeling standard in software engineering. In order to allow a straight-through modeling approach from business models over business process models to software artifacts, it is desirable to use a common modeling approach. Therefore we propose to specify a UML profile for business modeling integrating all benefits of these methodologies in one ontology. As a result this new ontology helps to cover our main research question - the transition between a business model and a business process model. Furthermore the introduction of a framework for measuring the quality of business models as well as the definition of business modeling patterns is discussed.

1. MOTIVATION

With the growing importance of web services, companies need to align their IT applications in order to compete within the growing service industry. However, the environment as well as customer decisions are changing over the time leading to a re-engineering of company's processes and business goals. In such fast changing environments it is of overall importance to align IT applications to the related changing company goals. Therefore a flexible design, implementation and delivery of B2B information systems is necessary, which links business modeling aspects with IT implementation.

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This approach is also reflected in the ISO 14662 standard on the Openedi reference model [15]. The reference model groups EDI related standards into two categories. i) The business operational view (BOV) addresses the semantics of electronic business, i.e. the semantics of business collaborations and related business information exchanges. Specifications going into the BOV capture business knowledge in a technology independent way. ii) The functional service view (FSV) addresses the technologies and the implementation aspects to support business collaborations specified in terms of BOV related specifications.

Figure 1 depicts an extension of the Openedi reference model. This three layer approach is proposed in one of our papers covering the different aspects of a B2B information system [13]. In other words, it is a model-driven top-down approach, in order to reach agreements between business partners (1) on the economic level, (2) the (inter-) organizational process choreography, and (3) on the services implementing the choreography. The upper layer describes the economic goals and values from a management perspective. It captures the rational as well as the economic resources being exchanged with business partners. The second layer in the middle specifies a flow of business activities and their dependencies specially designed to reach the business goals. The business models and the resulting business processes of the two BOV layers must be supported by IT systems on the FSV layer. Therefore the IT layer implements the business processes by means of tools, frameworks, API's, Web Services, etc. As one can recognize, the overall goal of this three layer approach is the mapping from business models to deployment artifacts.

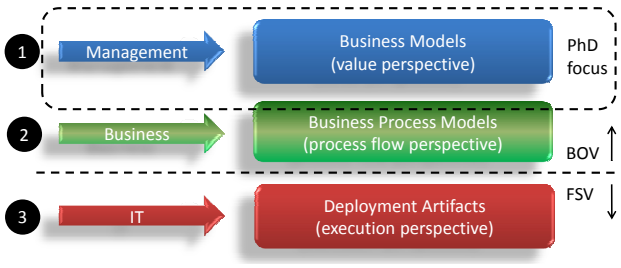

Figure 1: A 3-layer approach - from business models to software artifacts

We, the authors of this PhD proposal, are contributing to a

national funded IT project, called BSopt (Business Semantics on top of process technology)[1], where this three layer approach has its origin from. Within this project we are both responsible for the elaboration of the top layer and the transition to the second one. Therefore our PhD thesis focuses on the top layer - the business modeling layer. In order to get an overview about the different business modeling methodologies we firstly establish a survey about the existing approaches. Secondly we compare these approaches with each other to see where they differ and elaborate potential shortcomings. Moreover, we propose a methodology in order to measure the quality of business models. Furthermore, the reuse of business modeling patterns is an important issue of our PhD thesis. This will be established by the definition of a global business modeling ontology, incorporating aspects of other approved ontologies in this area. Finally, the transition from a business model (layer 1) to a business process model (layer 2) covers the main research question in our PhD thesis.

2. PROBLEM

As motivated in section 1, integrating business processes into a Service Oriented Architecture (SOA) is certainly a hot topic. However, most current approaches are limited to the technical process aspects, disregarding the economic drivers of the information society. In order to open-up enterprise applications to e-business and make them profitable for a communication with other enterprise applications, a business model is needed showing the business essentials of the e-commerce business case to be developed. In former days business modeling was done by using standard process modeling methodologies such as UML's activity diagrams [24], Petri Nets [25], IDEF0 [1] or STRIM [22]. Since these methodologies have been designed for modeling a sequence of activities, modelers tend to develop their business models in a workflow-oriented way. Therefore specific business modeling techniques have been introduced in order to capture the business perspective of an e-commerce information system.

There are three major business modeling methodologies our thesis is focusing on. Firstly, the e3-value methodology has been developed to model a value web consisting of actors who create, exchange, and consume things of economic value such as money, physical goods, services, or capabilities [8]. It is an ontology-based methodology for modeling and designing business models for business networks incorporating concepts from requirements engineering and conceptual modeling. Secondly, the REA (Resource-Event-Agent) Ontology is an approach for gathering the rationale behind business collaborations [7]. REA captures the declarative semantics of the collaborative space between enterprises from an economic viewpoint. It describes the involved actors (A), their value exchanges (R) and holds the triggers for economic exchanges by the means of economic events (E). Finally, the Business Model Ontology (BMO) [20] describes business models with respect to four elements and their relationships: product innovation, infrastructure management, customer relationship and financial aspects. In contrast to e3-value model, which describes the network constellation from a global point of view, the BMO ontology rather focuses on a specific actor and outlines his position in the business network and how he can make profit.

All these methodologies mentioned above have its own notations, concepts and rules. In order to allow a straight-through modeling approach between the different layers in the BOV as we proposed in figure 1, it is desirable to base the different steps in developing inter-organizational systems on a single modeling paradigm. Most of the business process modeling steps in the second layer are already based on the Unified Modeling Language (UML). This means that business process technologies customize the general purpose language UML by means of stereotypes, tagged values and constraints for their specific purpose. Therefore we will create a UML profile for business modeling integrating all benefits of these methodologies in one ontology.

Since business models are the starting point for the design of an information system and the driver for an alignment of the business processes of an enterprise, it is important to measure the quality of a business model. Although the term quality has been defined in many ways, ranging from extremes as *conformance to requirements* to *fitness for use* [16], we will specify a small set of quality properties for our metrics. Thus, we investigate business models for their effectiveness, efficiency, suitability, completeness and coherence, in order to define a framework for measuring the quality of business models.

A major research question to solve in our PhD thesis is the transition from business models to business process models. Thus, it is important to identify the dependencies between the approaches on the management layer and the business layer. This is a prerequisite to define a semiautomatic mapping between the artifacts on the different layers and to reflect changes on one layer to the other ones. As a demonstrating business process modeling methodology for our approch we take UN/CEFACT's Modeling Methodology (UMM) [11] and the Business Process Modeling Notation (BPMN) [18].

3. METHODOLOGY

In order to solve the identified problems we subdivide our approach into 4 parts as depicted in figure 2. Part 1 evaluates current business modeling approaches to show similarities, strengths and weaknesses. The result of this survey is a general description of relevant concepts for business modeling. Part 2 will cover all necessary aspects in order to link business models to business process models. To provide interoperability and best practices a UML profile based on the resulting description developed in part 1 is required. Additional to the UML profile quality measurement methods for business models as well as reuse, and classification principles will be considered in part 3 and 4. The final achievement of our thesis is a holistic UML profile which is able to cover business modeling aspects and combines relevant concepts from mature business modeling ontologies.

3.1 Evaluation of current business modeling approaches

The field of business modeling is a broad and complex domain. As introduced in section 2 there exist several solutions

[1] http://www.bsopt.at

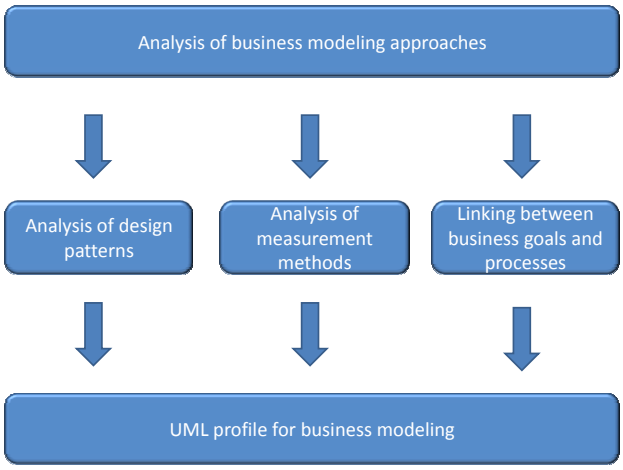

Figure 2: From the analysis of business models to a UML profile

which try to contribute their part to business modeling research. Theses ontological approaches are focusing on different aspects within the field of business modeling. Hence, a survey in order to investigate existing similarities between these ontologies, as well as their strengths and weaknesses will be necessary.

First steps towards a general description for business models have been done by [2] where a reference ontology for business models was introduced. The survey is focused on inter-organizational processes and includes concepts from operational and knowledge level. Therefore, their survey is an optimal starting point for our investigations on business models. In contrast to the reference ontology our exploration purpose is more widespread and can be summarized as follows:

- A comprehensive evaluation of the major business modeling ontologies.
- An overview about strengths and weaknesses of current modeling approaches.
- Review about similarities of concepts.
- Identification of shortcomings.
- First indications to link business models with business process models.
- New cognitions concerning a method to measure business model quality.

Additionally we will examine concepts from more broader approaches like the Business Motivation Model (BMM) developed by the Object Management Group (OMG). BMM is primely focused on the development of business plans and supports the modeling of so called ends, means, and influences an enterprise has to overcome in order to reach its business goals [**?**].

3.2 Linking between business models and business process models

Flexibility in concerns with services requires a persistent path from management (business models) to business (business process models) and finally IT (deployment artifacts like web services). In order to provide such a persistence a semi-automated mapping between each of these layers is necessary [5]. Therefore, the overall goal is to abstract business behavior from technical aspects. However, this thesis focus on the linking between business goals and business processes. Business modeling approaches like REA, e3-value, and BMO will be used to capture management aspects. These technologies are represented in their own proprietary notation technically specified by formats such as the Resource Description Framework (RDF)[17] or the Web Ontology Language (OWL)[4].

In order to overcome these limitations we propose to specify a UML profile for the general business ontology described in section 3.1. First approaches towards a definition of a UML profile have been outlined in [14]. In this paper work the authors focus on a mapping from the e3-value ontology to UML. According to their investigations not all aspects of e3-value could be integrated into the UML profile. Nevertheless the developed UML profile captures all necessary aspects to link UN/CEFACT's Modeling Methodology (UMM) with their e3-value profile. However, this approach highlights the mapping between business and business process models.

3.3 Quality measurements for business model ontologies

Current business modeling approaches focus primarily on economical indicators. E.g., BMO and e3-value have integrated concepts to analyze monetary flows within a business model. According to [21] BMO distincts between three evaluation elements: (1) The *revenue model* which measures the ability of a firm to generate incoming revenue or with other words translate offered value into money. (2) *Cost structure* shows all costs the firm incurs in order to create, market and deliver value to its customers. (3) And finally the *profit module* which is the output of revenue model and cost structure. A less widespread concept is supported by e3-value. The e3-value editor allows to generate net value flow spreadsheets to assess economic sustainability on a per enterprise basis [10]. Such spreadsheets express the economic value flow for each participant in the value network.

The introduced concepts are both pure economical and therefore do not state the architectural quality of the underlaying business model. Hence, our measurement approach is more focused on the business model graph. In order to realize such a solution the first step will be to evaluate measurement metrics which indicate significant information about the business model. E.g., the number of partners or the complexity of the graph itself which can be measured trough value flows or relations within the network. In the following we introduce a metric for evaluating the quality of business models regarding different quality properties - such as e.g. effectiveness, efficiency, suitability, completeness and coherence.

3.4 Design Patterns and Classification

Design patterns have been introduced to the object-oriented world in the 90s and since then got more and more popular. In OOP a design pattern is defined as *an abstract key aspect of a common design structure that make it useful for creating a reusable object-oriented design.* [6]. The use of design patterns allows to solve common problems in a clean and reusable way by abstracting the problem structure. However, a design pattern in the field of business modeling can be seen as an abstraction of business behavior. In [12] the most common business patterns were introduced and implemented using the REA ontology. The author depicts the fundamental patterns such as economical exchange, conversion, value chains, etc.

Another approach for capturing and managing business models is presented in [19]. The author presents the idea of business model portfolios. He argues that a stock of business models can help an enterprise to cope with change and innovation. A first step toward such an business portfolio is the classification of business models. Michael Rappa [23] identified 9 different basic e-business models. An automated identification process could lead to a template based business modeling approach which would increase the usability and reuse of innovative business models.

This thesis aims to combine the introduced concepts and develop a holistic framework which allows to combine business patterns with business ontologies. Therefore our PhD thesis covers the following issues:

- A method to analyze business model structures.
- Template based modeling approach.
- Classification of business models according to Rappa.

4. RELATED WORK

Especially with the rise of SOA business modeling has become more and more important to face nowadays business challenges. Several design approaches have been initiated. The most popular solutions are the Resource-Event-Agent Ontology (REA), the Business Modeling Ontology (BMO) and e3-value. A comparison between BMO and e3-value showed that the main difference between them is the point of view they address business modeling [9]. REA and BMO propose to capture a whole enterprise, whereas REA intends to focus on an economical point of view. BMO captures aspects such as infrastructure management, customer relationships, and capacities as well as financial aspects [19]. In contrast to BMO e3-value addresses collaborative networks and the exchange of value objects [8]. In [2] the authors examined each solution and tried to shape a general understanding for the different business modeling aspects. However, their approach does not consider measurement methods or analytical problems, design patterns or the linking between business models and business process models. Our dissertation aims to close these gaps. Regarding the transformation of business models towards business process models we examined the work of Andersson et al. In [3] the authors discuss the problem of how to go from a business model to a process model in a systematic way.

5. CONCLUSION

The introduced holistic approach shows current lacks in the field of business modeling. Using the approach from our dissertation current business modeling issues such as the linking between business models and business process models, business model measurements and design patterns for effective reuse of innovative business models will be examined. The final result of our PhD thesis will be a UML profile which enables UML supported modeling of business models.

6. REFERENCES

[1] IDEF0 method report. Technical report, http://www.idef.com/Complete Reports/idef0, 1981.

[2] B. Andersson, M. Bergholtz, A. Edirisuriya, T. Ilayperuma, P. Johannesson, J. Gordijn, B. Grégoire, M. Schmitt, E. Dubois, S. Abels, A. Hahn, B. Wangler, and H. Weigand. Towards a reference ontology for business models.

[3] B. Andersson, M. Bergholtz, B. Gregoire, P. Johannesson, M. Schmitt, and J. Zdravkovic. From Business to Process Models Ű a Chaining Methodology. In *Inproceedings of BUSITAL 06 Workshop*, 2006.

[4] M. Dean and G. Schreiber. Owl web ontology language reference. see http://www.w3.org/tr/2003/pr-owl-ref-20031215.

[5] J. Dorn, C. Grün, H. Werthner, and M. Zapletal. A survey of b2b methodologies and technologies: From business models towards deployment artifacts. In *Proc. 40th Annual Hawaii International Conference on System Sciences HICSS 2007*, Jan. 2007.

[6] E. Gamma, R. Helm, R. Johnson, and J. Vlissides. *Design Patterns. Elements of Reusable Object-Oriented Software*. Addison-Wesley Professional Computing Series. Addison-Wesley, 1995.

[7] G. Geerts and W. E. McCarthy. The ontological foundation of rea enterprise information systems. Technical report, Tech. Report, 2000.

[8] J. Gordijn and H. Akkermans. Value based requirements engineering: Exploring innovative e-commerce idea. *Requirements Engineering Journal*, 8(2):114–134, 2003.

[9] J. Gordijn, A. Osterwalder, and Y. Pigneur. Comparing two business model ontologies for designing e- business models and value constellations. Technical report, 18th Bled eConference eIntegration in Action, 2005.

[10] J. Gordjin and H. Akkermans. Early requirements determination for networked value constellations: A business ontology approach. Technical report, Free University Amsterdam VUA, 2006.

[11] B. Hofreiter, C. Huemer, P. Liegl, R. Schuster, and M. Zapletal. UN/CEFACT'S Modeling Methodology (UMM): A UML Profile for B2B e-Commerce. In *ER (Workshops)*, pages 19–31. Springer LNCS, United States, 2006.

[12] P. Hruby. *Model-Driven Design Using Business Patterns*. Springer-Verlag Berlin Heidelberg, 2006.

[13] C. Huemer, P. Liegl, R. Schuster, and M. Zapletal. A 3-level e-Business Registry Meta Model. In *Proceedings of IEEE International Conference on Services Computing SCC 2008*, 2008.

[14] C. Huemer, A. Schmidt, H. Werthner, and M. Zapletal. A UML Profle for the e3-Value e-Business Model Ontology. 2008.

[15] ISO. *Open-edi Reference Model*, 2004. ISO/IEC JTC 1/SC30 ISO Standard 14662, Second Edition.

[16] J. M. Juran. *Quality Control Handbook*. McGraw-Hill, 1979.

[17] O. Lassila and R. Swick. Resource description framework (rdf) model and syntax specification. see http://citeseer.ist.psu.edu/article/lassila98resource.html.

[18] OMG. *Business Process Modeling Notation - BPMN*, 2006.

[19] A. Osterwalder. *The Business model Ontology a Proposition in a Design Science Approach*. PhD thesis, Universite de Lausanne, 2004.

[20] A. Osterwalder, C. Parent, and Y. Pigneur. Setting up an ontology of business models. In *CAiSE Workshops (3)*, pages 319–324, 2004.

[21] A. Osterwalder and Y. Pigneur. An e-business model ontology for modeling e-business. Technical report, 15th Bled Electronic Commerce Conference e-Reality: Constructing the e-Economy, 2002.

[22] M. A. Ould. *Business Processes - Modelling and Analysis for Re-engineering and Improvement*. John Wiley and Sons, 1995.

[23] M. Rappa. Business models on the web. online, 2008. http://digitalenterprise.org/models/models.html.

[24] J. Rumbaugh, I. Jacobson, and G. Booch. *The Unified Modelling Language Reference Manual*. Addison-Wesley, 1999.

[25] K. van Hee. Informations Systems Engineering - A formal approach. *Cambridge University Press*, 1994.